# Music and the Brain: Differences in the Perception of Two Tuning Frequencies

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## Abstract

Based on the theory that humans unconsciously prefer music tuned to 432Hz, musicians debate whether the tuning standard stay at 440Hz or move to 432Hz. Results of this study did not support the hypothesis that people have a preference for either frequency but there are implications for further research into how tuning impacts listener's arousal factors.

## Introduction

**Question: Do humans have a preference for a specific tuning frequency centered around either 432 Hz or 440 Hz?**

In 2016, Enzo Crotti, a proponent of 432Hz tuning, built upon this finding and explained how pitches and resonances may play a role in human spirituality and emotion, affecting human behavior due to an innate tendency to prefer the 432Hz tuning standard based on physiological arousal (Crotti, 2016). To study emotional reactions, researchers focus on quantitative characteristics such as the type, known as valence and its intensity, referred to as arousal. A preference for a certain aspect of music would be a combination of positive valence and high intensity arousal. In reference to pitch and tuning discrepancies, very few studies have been conducted which look at preferences.

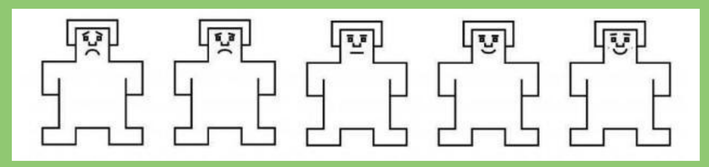
Taking previous research into account, this study aimed to look at differences in the reactions of participants between two tuning frequencies. The researchers hypothesized that participants listening to musical excerpts at both tuning frequencies would report emotional and physiological reactions that suggest a preference for one tuning frequency.

## Method

Participants were recruited via surveycircle.com, Facebook, Reddit, Instagramm and through an email list of Manhattan College students (n=90). Of the 90, 31 participants wore biological sensors that measured heart rate and Galvanic Skin Response (GSR) while taking the same survey. Part one of the study measured emotional reactions, recording emotional valence and arousal. Part two of the study required participants to wear biological sensors in order to measure physiological reactions.

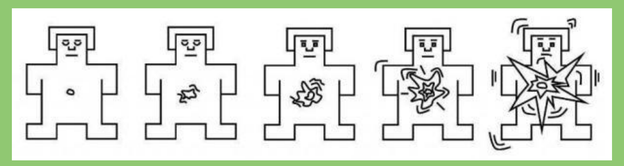
An online survey of 20 questions plus 6 demographic questions was created on and distributed through Qualtrics. The survey included 10 sound clips, That featured 5 string instruments : Violin, Ukulele, Piano, Guitar, and Bass. Each instrument was recorded twice; once tuned at 440 Hz and the other when tuned to an A at 432Hz. The Self-Assessment Manikin (SAM) to measure emotional valence and arousal (Stevens, Murphy, & Smith, 2017).

*Which of the following figures best represents your emotional reaction to the sound clip?*



Measure of Emotional Valence

*Which of the following figures best represents the intensity of the emotion you described in the previous question (e.g. weak or strong)?*



Measure of Emotional Arousal

## Results

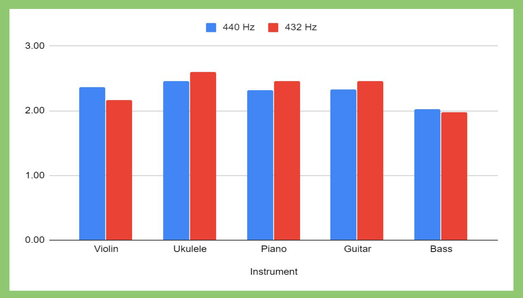



*Figure 1.* Means of arousal ratings by instrument and tuning frequency.

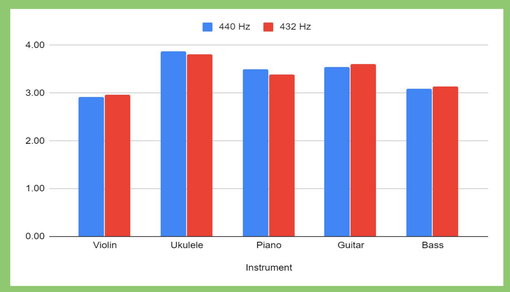



*Figure 2*. Means of valence ratings by instrument and tuning frequency.

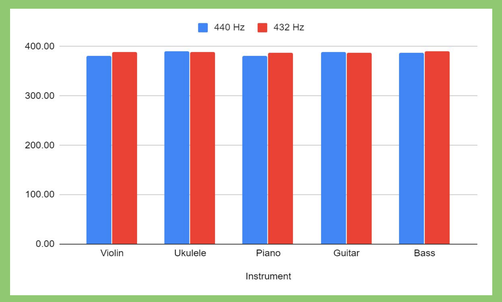
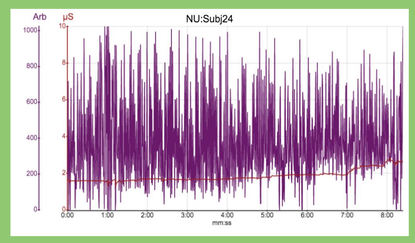


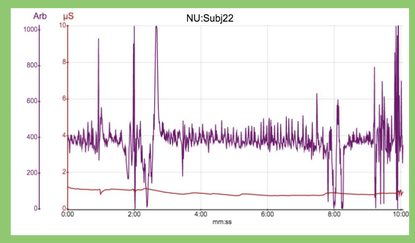

*Figure 3*. Heart rate means by instrument and tuning frequency.

According to a repeated measures ANOVA, significant main effects were found between:

1. Valence rating and instrument type, $F=12.029$, $p=0.000$, $\eta_p^2 = 0.119$
2. Arousal rating and tuning frequency, $F=5.242$, $p=0.024$, $\eta_p^2 = 0.056$
3. Arousal rating and instrument type, $F=3.559$, $p=0.009$, $\eta_p^2 = 0.038$
4. Heart rate and tuning frequency, $F=5.327$, $p=0.028$, $\eta_p^2 = 0.151$

- Post hoc analysis for valence ratings revealed there were significant mean differences between the violin and piano (p=0.087), ukulele and piano (p=0.085), piano and bass (p=0.083), guitar and violin (p=0.008), and the guitar and piano (p=0.002)
- Post hoc analysis for heart rate showed significant mean differences between the 440 Hz and 432 Hz tuning frequencies (p=0.024), violin and bass (p=0.006), ukulele and piano (p=0.016), and the piano and bass (p=0.001).
- Post hoc analysis for heart rate revealed significant mean differences between the 440 Hz and 432 Hz tuning frequencies (p=0.028).




*Figures 4 & 5.* Examples of Neulog data for 2 different participants demonstrating responses to all of the music clips to exhibit differences in heart rate (beats per 5 minutes) and skin conductance, (Arb).

## Discussion

- The original hypothesis was not fully supported by the repeated-measures ANOVAs since there were no significant differences between the tuning frequencies for both valence and arousal.
- However, instrument type led to significant differences between valence and arousal ratings of the 2 frequencies and should be examined further [Figures 1&2].
- A significant effect seen within heart rate indicates that the 432 Hz (*M*= 388.682, *SD*= 0.795) tuning frequency innervates a significantly greater physiological response compared to 440 Hz (*M*= 385.970, *SD*= 1.406) [Figure 3].
- Similar to other studies, these results suggest other factors, such as timbre, may influence preferences for either tuning frequency (Palmblad, 2018).
- Future studies are needed to delve deeper into the connection between music and the human experience by measuring various aspects of behavior, consisting of emotional and physiological reactions to music.

## References

- Palmblad, S. (2018). A= 432: A superior tuning or just a different intonation? How tuning standards affects emotional response, timbre and sound quality in music.
- Stevens, F., Murphy, D. T., & Smith, S. L. (2017). Soundscape categorisation and the self-assessment manikin. In *Proceedings of the 20th International Conference on Digital Audio Effects (DAFx-17), Edinburgh, UK*.
- Crotti, E. (2016). Integral 432 Hz Music: Awareness, Music and Meditation. Wenz Books, 36-37. .